



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

July 5, 2018

MEMORANDUM TO: Samuel S. Lee, Chief
Licensing Branch 1
Division of Licensing, Sitting,
and Environmental Assessment
Office of New Reactors

FROM: Marieliz Vera, Project Manager /RA/
Licensing Branch 1
Division of Licensing, Sitting,
and Environmental Assessment
Office of New Reactors

SUBJECT: SUMMARY OF THE JUNE 12, 2018, CATEGORY 1 PUBLIC
TELECONFERENCE WITH NUSCALE POWER, LLC DESIGN
CERTIFICATION APPLICATION SECTION 3.7, "SEISMIC
DESIGN," AND 3.8, "DESIGN OF CATEGORY I STRUCTURES"

The U.S. Nuclear Regulatory Commission (NRC) held a Category 1 public teleconference on June 12, 2018, to discuss Final Safety Analysis Report (FSAR) Tier 2, Chapter 3, "Design of Structures, Systems, Components and Equipment," and Sections 3.7, "Seismic Design" and 3.8, "Designs of Category I Structures," of the NuScale Power, LLC (NuScale) Design Certification. Participants included personnel from NuScale and members of the public.

The public meeting notice can be found in the Agencywide Documents Access and Management Systems under Accession No. ML18162A214. This meeting notice was also posted on the NRC public Website.

The meeting agenda and list of participants can be found in Enclosures 1 and 2, respectively. The technical issues discussed are included in Enclosure 3.

CONTACT: Marieliz Vera, NRO/DNRL
301-415-5861

Summary:

The purpose of this meeting was to discuss the responses for Requests for Additional Information (RAI) 8934, Question 03.07.02-15 (ML17355A678, ML18127B711); RAI 8974, Question 03.08.04-21 (ML17276B887, ML17363A436, ML18081A592); RAI 8963, Question 03.08.05-22 (ML18094B105, ML17290B267); RAI 8932, Question 03.07.02-4 (ML18120A261); RAI 8936, Question 03.07.02-7 (ML18031B204); RAI 8936, Question 03.07.02-10 (ML17217A004); RAI 8966, Question 03.08.04-03 (ML18031B317); RAI 8974, Question 03.08.04-23 (ML17276B887, ML18099A359). The feedback from the NRC staff, on RAIs 8934, 8974, and 8963, is discussed in Enclosure 3

For RAI 8934, Question 03.07.02-15, the applicant will provide a follow-up RAI response reflecting the NRC staff's feedback on the missing fluid-structure interaction (FSI) hydrodynamic effect on structural demands for Reactor Building (RXB), confirming that the 1.28 x gravity load bounds a 4.2 pounds per square inch (psi) pressure profile.

Regarding RAI 8974, Question 03.08.04-21, the NRC staff requested NuScale to clarify the demand/capacity (D/C) ratios for the NuScale Power Module (NPM) lug restraints associated with concrete bearing. The NRC staff indicated that based on proposed FSAR markups and previous FSAR descriptions, the FSAR appeared to provide two D/C ratios related to concrete bearing for the same structural member. NuScale clarified that the multiple D/C ratios, with respect to concrete bearing, are for different components of the NPM lug restraint. NuScale committed to clarify the FSAR description to indicate the specific components for which D/C ratios for concrete bearing are provided. Further, in response to the NRC staff question, NuScale clarified that the through bolts are considered to be under tension only (i.e. not shear and tension). Additionally, the NRC staff requested NuScale to provide the D/C ratio(s) associated with the shear lugs, which are credited for transferring the shear loads from the lug restraint bumpers to the concrete. NuScale committed to provide the D/C ratios for the shear lugs and the other components of the NPM support(s), possibly in tabular form. Lastly, NuScale committed to clarify the ultimate strength value provided for the shear lugs in Sections 3B.2.7.4 and 3B.2.7.4.1. The NRC staff's feedback will be addressed in a supplement to the response.

RAI 8963, Question 03.08.05-22 item (f) of the NRC staff's feedback (Enclosure 3) was resolved during the meeting. The remaining feedback on RAI 8963, Question 03.08.05-22 will be addressed in a supplement to the response.

RAI 8932, Question 03.07.02-4, the NRC staff received the response (ML18157A262) on June 6, 2018, and the staff is evaluating the response.

RAI 8936, Question 03.07.02-7, the applicant will provide a follow-up RAI response reflecting the NRC staff's feedback on SASSI2010 verification and validation (V&V), demonstrating that the parameters used in NuScale seismic demand calculations are within the range of applicability of SASSI2010. NuScale will provide a new submittal date for the follow-up response.

RAI 8936, Question 03.07.02-10 and RAI 8966, Question 03.08.04-03 responses NuScale is performing their final review and the response will be coming the next couple of days.

RAI 8974, Question 03.08.04-23, NuScale indicated its approach to address the NRC staff's feedback. With respect to the in-structure response spectra (ISRS) to be used for equipment that may be attached to walls, the NRC staff emphasized that such ISRS should consider the

amplified out-of-plane response near the center of the wall. With respect to the NRC staff's request for ISRS at the NPM support locations, in response to NuScale's clarification question, the staff indicated that the ISRS at the NPM support skirt location, similarly as for the ISRS at the lug restraint location, should be consistent with the input case(s) used for the NPM analysis documented in TR-0916-51502. With respect to the NRC staff's request for FSAR markups identifying the specific FSAR Figures and/or Tables and/or Sections containing the Maximum forces in NPM lug restraints and skirts, NuScale indicated that the FSAR markups will be provided in the response to RAI 8974, Question 03.08.04-23 rather than in the response to RAI 8936, Question 03.07.02-10. The NRC staff's feedback will be addressed in a supplement to the response.

Docket No. 52-048

Enclosures:

1. Meeting Agenda
2. List of Attendees
3. NRC Feedback on RAIs

cc w/encls.: DC NuScale Power, LLC Listserv

SUBJECT: SUMMARY OF THE JUNE 12, 2018, CATEGORY 1 PUBLIC TELECONFERENCE WITH NUSCALE POWER, LLC DESIGN CERTIFICATION APPLICATION SECTION 3.7 "SEISMIC DESIGN," AND 3.8, "DESIGN OF CATEGORY I STRUCTURES" DATE: JULY 5, 2018

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CATEGORY 1 PUBLIC TELECONFERENCE WITH NUSCALE POWER, LLC

DESIGN CERTIFICATION APPLICATION SECTION 3.7, "SEISMIC DESIGN," AND 3.8,

"DESIGN OF CATEGORY I STRUCTURES"

June 12, 2018

10:30 p.m. – 12:00 p.m.

AGENDA

Public Meeting	
10:30-10:35am	Welcome and Introductions
10:35-11:55am	Discussion of the Request for Additional Information
11:55-12:00pm	Public - Questions and Comments

U.S. NUCLEAR REGULATORY COMMISSION

CATEGORY 1 PUBLIC TELECONFERENCE WITH NUSCALE POWER, LLC

DESIGN CERTIFICATION APPLICATION SECTION 3.7, "SEISMIC DESIGN," AND 3.8,

"DESIGN OF CATEGORY I STRUCTURES"

LIST OF ATTENDEES

June 12, 2018

NAME	AFFILIATION
Marieliz Vera	U.S. Nuclear regulatory Commission (NRC)
Manas Chakravorty	NRC
Sujit Samaddar	NRC
Ata Istar	NRC
Bhagwat Jain	NRC
Robert Roche-Rivera	NRC
George Wang	NRC
Sunwoo Park	NRC
Marty Bryan	NuScale Power, LLC (NuScale)
Josh Parker	NuScale
J.J. Arthur	NuScale
Amber Berger	NuScale
Tom Ryan	NuScale
Kirsten McKay	NuScale
Mohsen Azadbakht	NuScale
Mohsin Kahn	NuScale
Marvin Lewis	Public
Sarah Fields	Public

U.S. NUCLEAR REGULATORY COMMISSION

CATEGORY 1 PUBLIC TELECONFERENCE WITH NUSCALE POWER, LLC

DESIGN CERTIFICATION APPLICATION SECTION 3.7, "SEISMIC DESIGN," AND 3.8,

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Staff Feedback on Request Additional for Information 8934

Question 03.07.02-15

- A. In its supplemental request for additional (RAI) response dated May 7, 2018, the applicant stated the following:

An actual pressure profile is not applied to the RXB walls and floor. The SASSI2010 analysis with lumped water masses does not represent fluid-structure-interaction (FSI) behavior, and, therefore, underestimates the hydrodynamic pressures on the RXB walls. In order to account for this, an ANSYS FSI analysis, in which the water elements were explicitly modeled, was performed. It was determined that an additional 4.2 psi of hydrodynamic pressure on the walls should be included. This additional pressure was added to the SAP2000 model as an equivalent static load by amplifying the gravity load by a factor of 1.28. A schematic of the hydrostatic and 'missing' hydrodynamic load is shown in FSAR Figure 3.7.2-129.

Final Safety Analysis Report (FSAR) Eq. 3.7-14 (Page 3.7-118, Revision 1) represents the corrected equivalent static pressure due to hydrodynamic effects (including 3D FSI). The applicant derived "missing" FSI pressure as difference between pressures obtained from Eq. 3.7-14 and from the original SASSI2010 lumped-mass analysis. In implementing the missing FSI pressure in SAP2000, the applicant did not apply an actual pressure profile (i.e., pressure differential between Eq. 3.7-14 and original SASSI2010). Instead, the applicant chose to amplify the gravity load by a factor of 1.28 in order to add missing FSI pressure loading to the SAP2000 model. The NRC staff's concern is whether the use of a gravity load factor will result in an equivalent or conservative design demand compared to the use of an actual pressure profile.

Therefore, the applicant is requested to provide figures or tables that compare pressure profiles on the pool walls and foundation obtained from the actual missing FSI pressure and from amplifying the gravity load by a factor of 1.28. If significant differences are identified in such comparison, the applicant should provide an evaluation demonstrating that the use of a gravity load factor of 1.28 results in an incremental design demand (forces, moments, deformations, etc.) that would have bound the increased demand should the applicant have used the actual pressure profile accounting for the missing FSI effect in SAP2000, for both the RXB pool walls and foundation.

- B. Explain how the "Water Weight" Dead Loads (FSAR Section 3.8.4.3.1.2) and "Liquid Loads" (FSAR Section 3.8.4.3.2) are distinct and implemented in SAP2000. Also, clarify whether such water weight/mass is implemented in SAP2000 for addressing hydrodynamic loads

only or both hydrodynamic and hydrostatic loads. Additionally, clarify whether the hydrostatic water pressure described in FSAR Section 3.8.4.3.2 is addressed in SAP2000 by applying an actual pressure profile to the pool walls and foundation or by the use of a gravity load factor. If the latter, address the adequacy of the use of a gravity load factor as requested in item "A" above also in the context of hydrostatic pressures.

- C. In a new proposed paragraph in the FSAR markup (middle of Page 3.7-122, Draft Revision 2), the applicant states, "The missing hydrodynamic load is added to the hydrostatic load to determine the total fluid pressure on the RXB walls." Here, pressure on the foundation is not mentioned. Please revise the sentence to include foundation. The proposed paragraph in the FSAR markup includes a statement, "These hydrodynamic effects from SASSI2010 are included in the Ess term of the governing load combination." Please refer to FSAR Section that provides the definition of Ess.
- D. In FSAR Section 3.7.2.1.2.4 (Revision 1), the applicant describes how the additional pressure on the pool walls accounting for the missing 3D FSI effects are obtained. However, it does not fully describe how the additional pressure on the pool foundation is obtained. For example, the applicant indicates that the wall pressures (for Segments X1, X2, ..., Y5) in Tables 3.7.2-2 and 3.7.2-3 are obtained by averaging the pressure values over the depth of the wall; however, it is not clear how the foundation pressures (Z Foundation) in these tables are obtained. Please augment FSAR Section 3.7.2.1.2.4 to include a description of how the additional pressure on the pool foundation accounting for the missing 3D FSI effects is obtained.
- E. In the paragraph under the title "Equivalent Static Pressure Estimation" (Page 3.7-118, Revision 1), a symbol, P_{add} , is introduced with a description of "additional equivalent static pressure." However, in view of FSAR Tables 3.7.2-4 to 3.7.2-6 (Revision 1), the symbol should denote "equivalent static pressure." Please clarify and make corrections as needed. The bottom paragraph under the title, "Development of Correction Factor" (Page 3.7-118, Revision 1) includes a statement, "Therefore, a 1.28g vertical static loading was added to the SAP2000 model to ensure this additional pressure is accounted for in the design." Here, the wording "1.28g vertical static loading" may cause a confusion that it induces only vertical pressure on the foundation. Please consider revising the statement so that it indicates both vertical pressure on the foundation and horizontal pressure on the walls are induced.

Staff Feedback on Request Additional for Information 8974

Question 03.08.04-21

In its response and proposed FSAR markups the applicant indicated that the most controlling mode of failure is bearing against concrete with a $D/C = 0.777$. However, FSAR Section 3B.2.7.4.1 states that the D/C ratio for the concrete bearing strength is 0.40. The NRC staff request the applicant to describe the differences between the aforementioned D/C ratios and or correct the apparent inconsistency, as applicable.

Further, the response and proposed FSAR markups indicate that because the shear lugs transfer the shear loads from the bumper to concrete, the through bolts are considered to be under tension only. However, FSAR Section 3B.2.7.4.1 provides the shear capacity of the trough bolts and respective D/C ratio for the bolts but no D/C ratio with respect to shear failure of the shear lugs. The NRC staff request the applicant to provide the D/C ratio with respect to shear failure of the shear lugs, clarify whether the through bolts are considered to be under

tension only as indicated above or both shear and tension as may be implied by the D/C ratio for the bolts with respect to shear describe in the FSAR, and provide FSAR markups accordingly.

Additionally, the NRC staff request the applicant to clarify in the FSAR the ultimate strength value provided for the shear lugs in Sections 3B.2.7.4 and 3B.2.7.4.1.

Staff Feedback on Request Additional for Information 8962

Question 03.08.05-22

- A. Editorial: On page 3.8-118 in Section 3.8.5.4.1.3, "Analysis of Control Building Basemat," the markups refers to "...X and Y directions," at two locations. Since no axes were depicted in some of the RAI response related figures providing results (e.g.; moments) in the FSAS – therefore, is difficult to identify global X and Y directions. Please update the figures to show global coordinate system. Furthermore, for correctness, in the body of the FSAR, "X and Y directions," may read "global X and Y axes."
- B. Editorial: Figures 3.8.5-4, -4a, -5, 5a, -6, -6a, -7, 7a depict Mxx and Myy of RXB and CRB basemat moments, but the applicant did not provide any description of those moments in the markups and in the body of the FSAR. Please describe and refer those figures in relevant sections of the FSAR.
- C. Editorial: On page 3.8-120 in Section 3.8.5.4.1.4, "Control Building Basemat Nonlinear Analysis Model Description," tunnel area is listed as "466.67 ft²," in the FSAR. However, it was calculated and tabulated in Table 3.8.5-9 as "500.6 ft²." Please, correct the apparent inconsistency or explain reasons for the different tunnel areas.
- D. Under "Static Demand": Applicant describes, "Three Moments (MX, MY, MZ) are obtained..." Further, the response states that the moments about the z-axis were not used. Please explain the reason for not using the moments about the z-axis.
- E. Under "Seismic Demand": Applicant is requested to provide additional information (e.g.; figures, discussions) showing how moments M1, M2, and M3 from the simple supported beams between walls (Figure 2), and added wall moments (M1 and M2) were determined from moments of Mxx, Myy, Mxy.
- F. It is not clear how the values of moments MX and MY in global X and Y axes would be the same value and at the same element as tabulated in Table 1, (357.4 k-ft/ft at element 397 – from both standalone and/or combine SASSI models). Clarify whether 357.4 k-ft/ft is the magnitude of both moments MX and MY and explain the reason for the same magnitude for both moments, or correct the values as necessary.
- G. Please explain why the settlements values were not provided for the CRB Tunnel area.